HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES
INSTITUTE OF TECHNOLOGY

Hungarian University of Agriculture and Life Sciences, Gödöllő

Mechanical engineering faculty

MSc Mechanical Engineering

Institute of technology

Technical Developer/YER3D9
Specialization / Neptun code

Unified Electric Vehicle (EV) main battery architecture, utilizing standardized hot-swappable modules of specialized capabilities

By:

Turchin-Muzykant Daniel

Supervisor: Dr. Pillinger György (PhD), Associate professor.

Department of Vehicle Technology

Gödöllő

2022

The past two decades saw a massive intake of EVs into the fleets of most countries around the world, these are manufactured and sold in ever growing numbers, with the premise of solving global warming and major reduction in polluting emissions, but this trend has its difficulties and environmental impacts of its own – mainly concerning the traction battery manufacturing.

In this thesis carries out a thorough assessment of current state of the art EV traction battery architecture and deployment, research of the EV market for current and future trends, design and technologies related to EVs and battery design, life-cycle of the vehicle and batteries, to finally redesign an alternative battery architecture that will have improved characteristics in current and future applications, such as better Raw materials utilization, Vehicle efficiency and Recyclability.

The current approaches used in the EV market are based around a single, large, elaborate and expensive battery pack, comprising of thousands of individual cells, tightly packed in the largest space available in the vehicle frame. This approach has major drawbacks when it comes to serviceability and recycling. Being a single unit, it has no scalability in mind and leads to major concern on the sustainability of EV production on the long run, as Lithium and other raw materials in Li-Ion battery is finite and with current mining pace is due to be exhausted before the end of this century.

A rethink of Traction battery design is called for, splitting the battery pack into more manageable modules, introducing scalability, improving serviceability. As an added feature it allows to upgrade the battery technology when better technology is available and introducing other energy supply types – such as supercapacitors and Fuel cell technology.

Proposed module design, with an in-depth description of concepts, main ideas, actual dimensions, and specifications is carried out in CAD, with useable parameters and approaches to house multiple battery cell types, thus proving the possibility of using a common size factor on the broad spectrum of EV batteries. Additionally the carrier frame specifications are laid out, finally supercapacitor and Fuel cell modules are designed to be used in conjunction with the battery module.

Finally, an assessment and comparison between current state of the art architecture and proposed approached is made using quantitative and qualitative parameters. The overall benefits and drawbacks are then named and explained in detail, with a view into future perspectives.